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**Ammar et al.**

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(54) **VEHICLE PUDDLE LAMP ASSEMBLY  
GENERATING ANIMATED IMAGE AND  
METHOD**

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- (\*) Notice: Subject to any disclaimer, the term of this  
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U.S.C. 154(b) by 192 days.

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- (51) **Int. Cl.**  
*F21V 5/00* (2015.01)  
*B60Q 1/24* (2006.01)  
*B60Q 1/26* (2006.01)  
*B60R 1/12* (2006.01)

- (52) **U.S. Cl.**  
CPC ..... *B60Q 1/24* (2013.01); *B60Q 1/2665*  
(2013.01); *B60R 1/12* (2013.01); *B60Q*  
*2400/40* (2013.01); *B60Q 2400/50* (2013.01)

- (58) **Field of Classification Search**  
CPC ..... F21V 5/00; F21V 7/04  
USPC ..... 353/2, 13, 95  
See application file for complete search history.

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“2008, 2009, 2010, 2011, 2012 Challenger MPAR Door Light Projector,” www.northamericantuning.com, Cpyrighted 2012 North American Tuning LLC, 7 pages.

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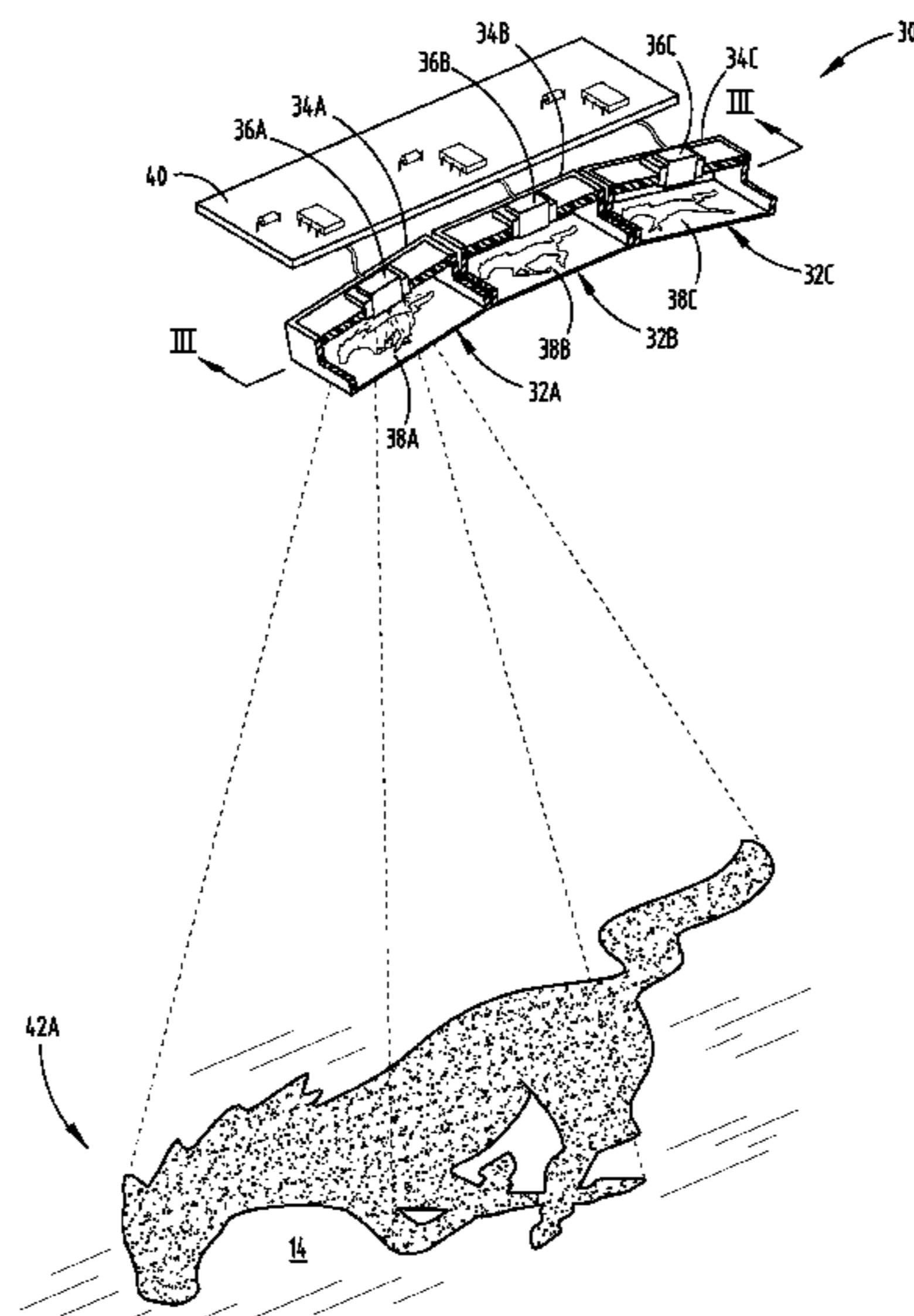
*Primary Examiner* — William C Dowling  
*Assistant Examiner* — Jerry Brooks

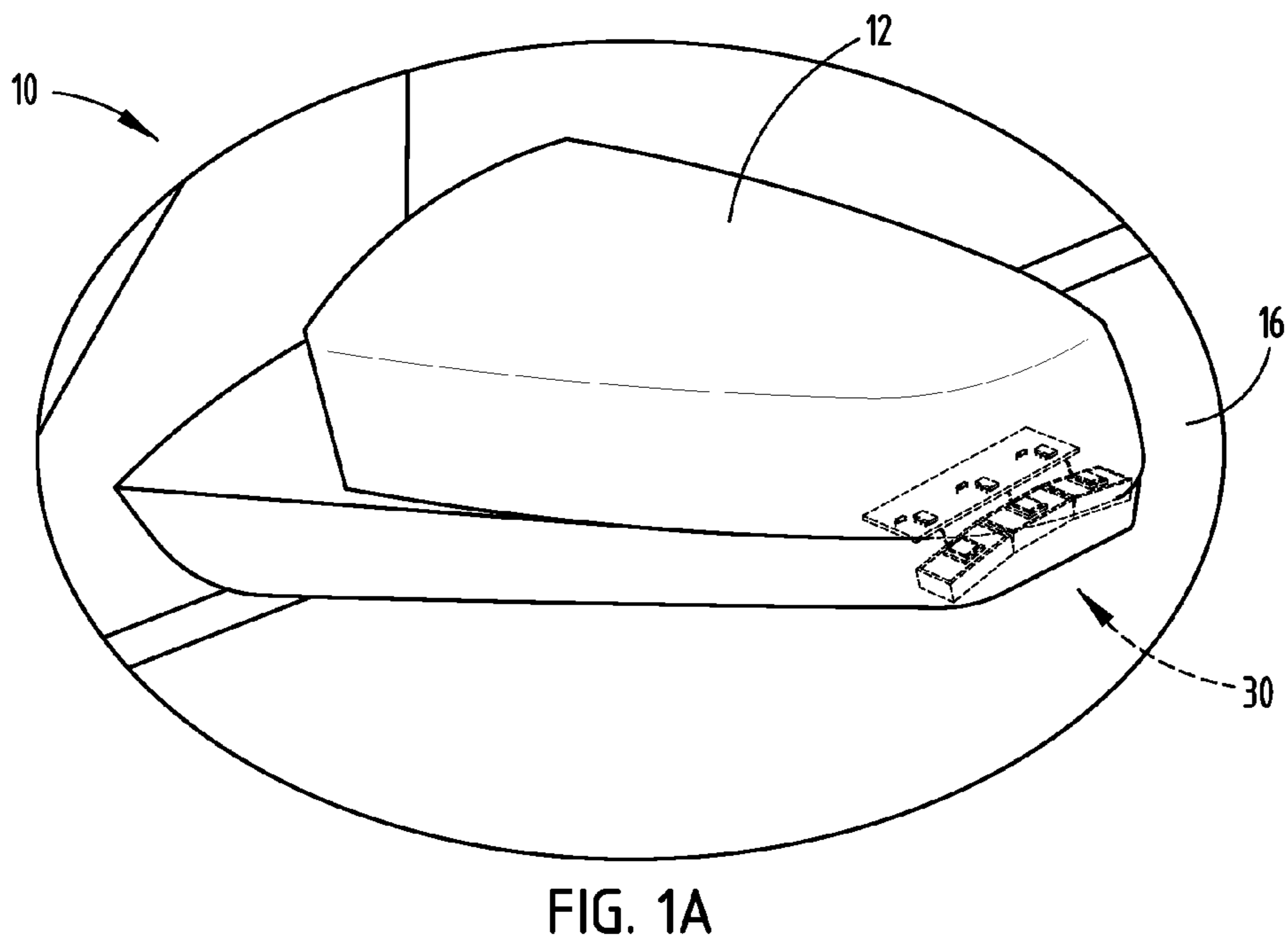
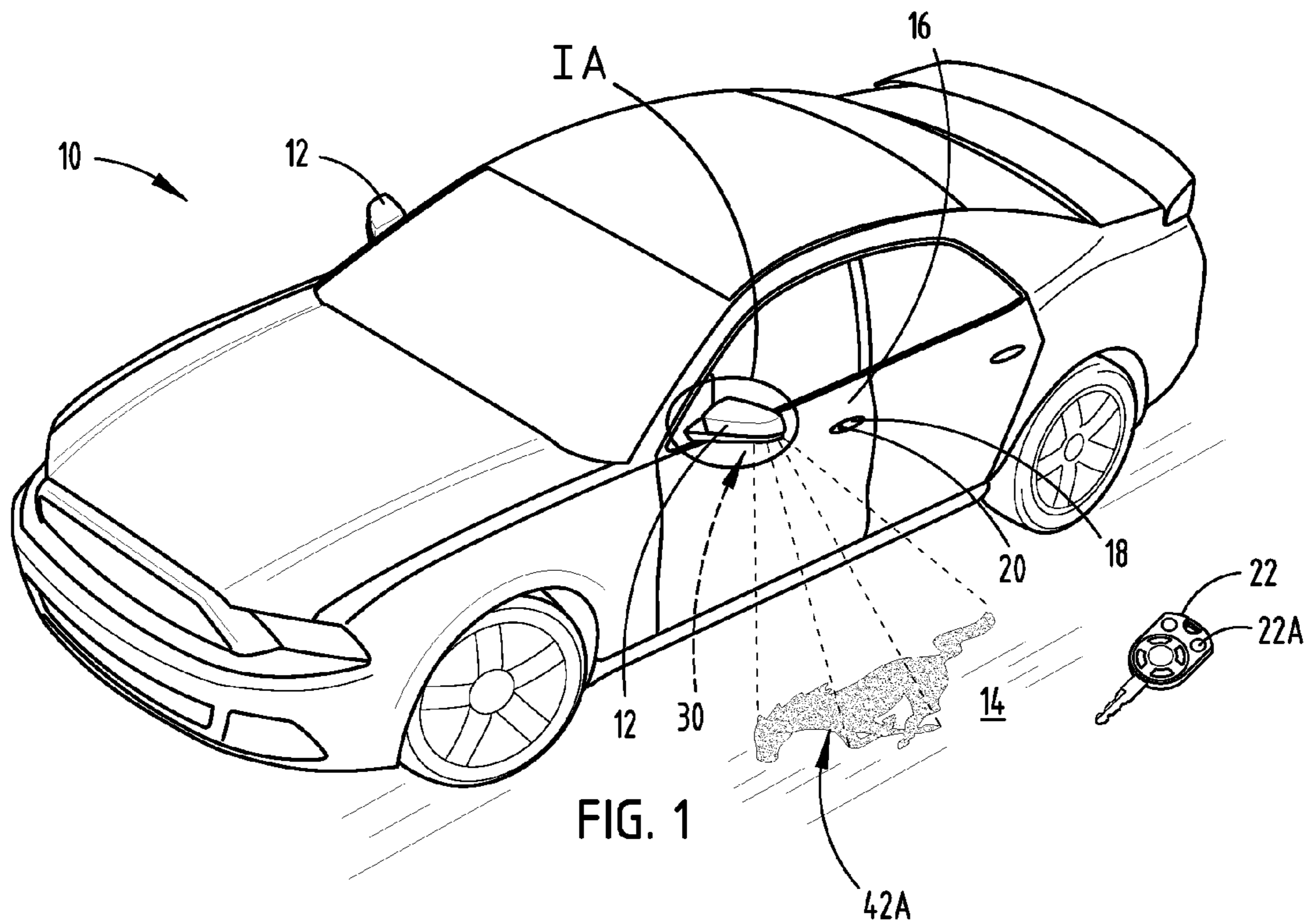
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(57) **ABSTRACT**

A vehicle puddle lamp assembly is provided and includes a plurality of light projectors located on a vehicle and configured to illuminate different lighted image patterns on a ground surface adjacent to the vehicle. The vehicle puddle lamp assembly also includes a controller for sequentially activating the plurality of light projectors to generate an animated lighted image on the ground surface.

**19 Claims, 7 Drawing Sheets**





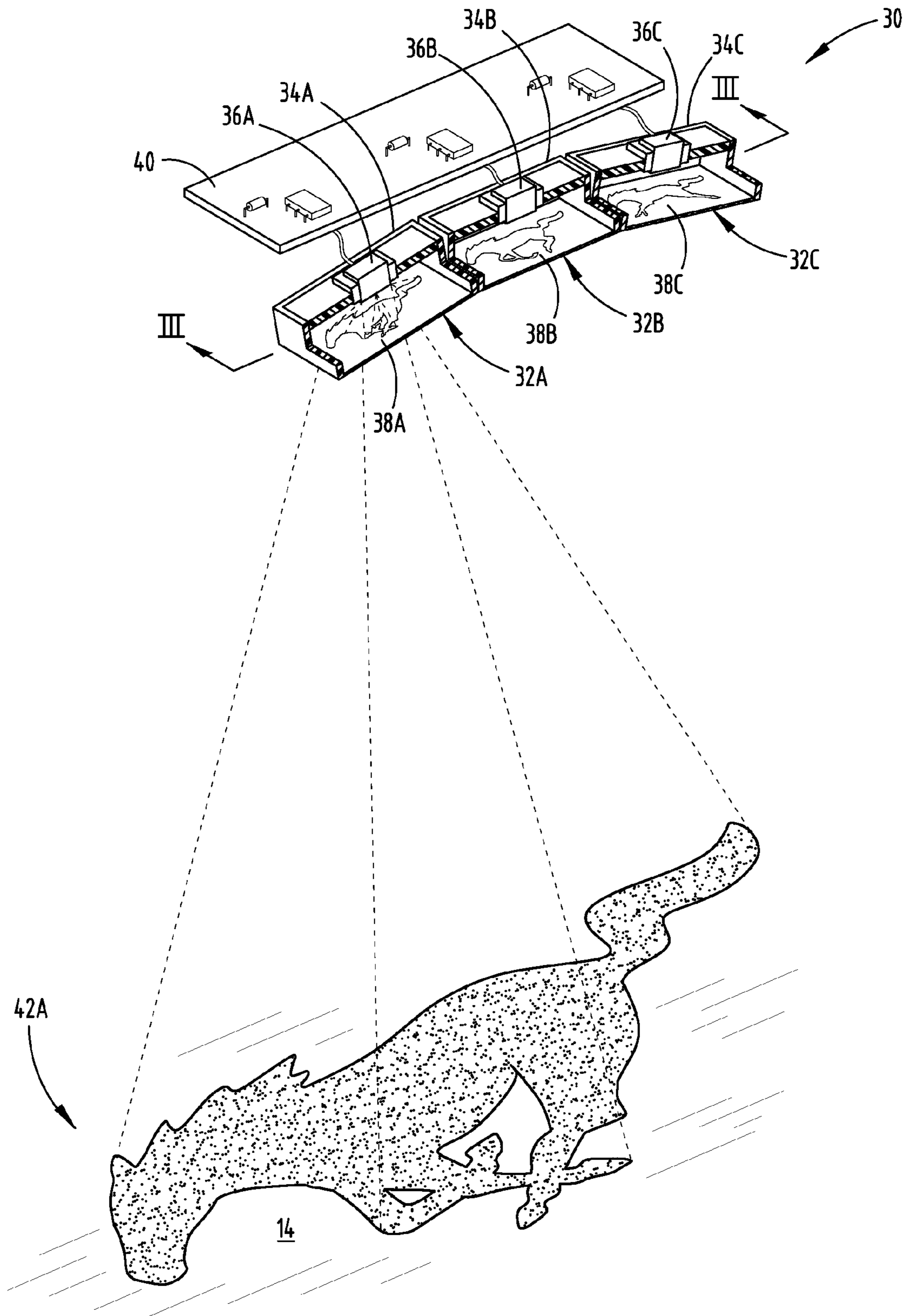


FIG. 2A

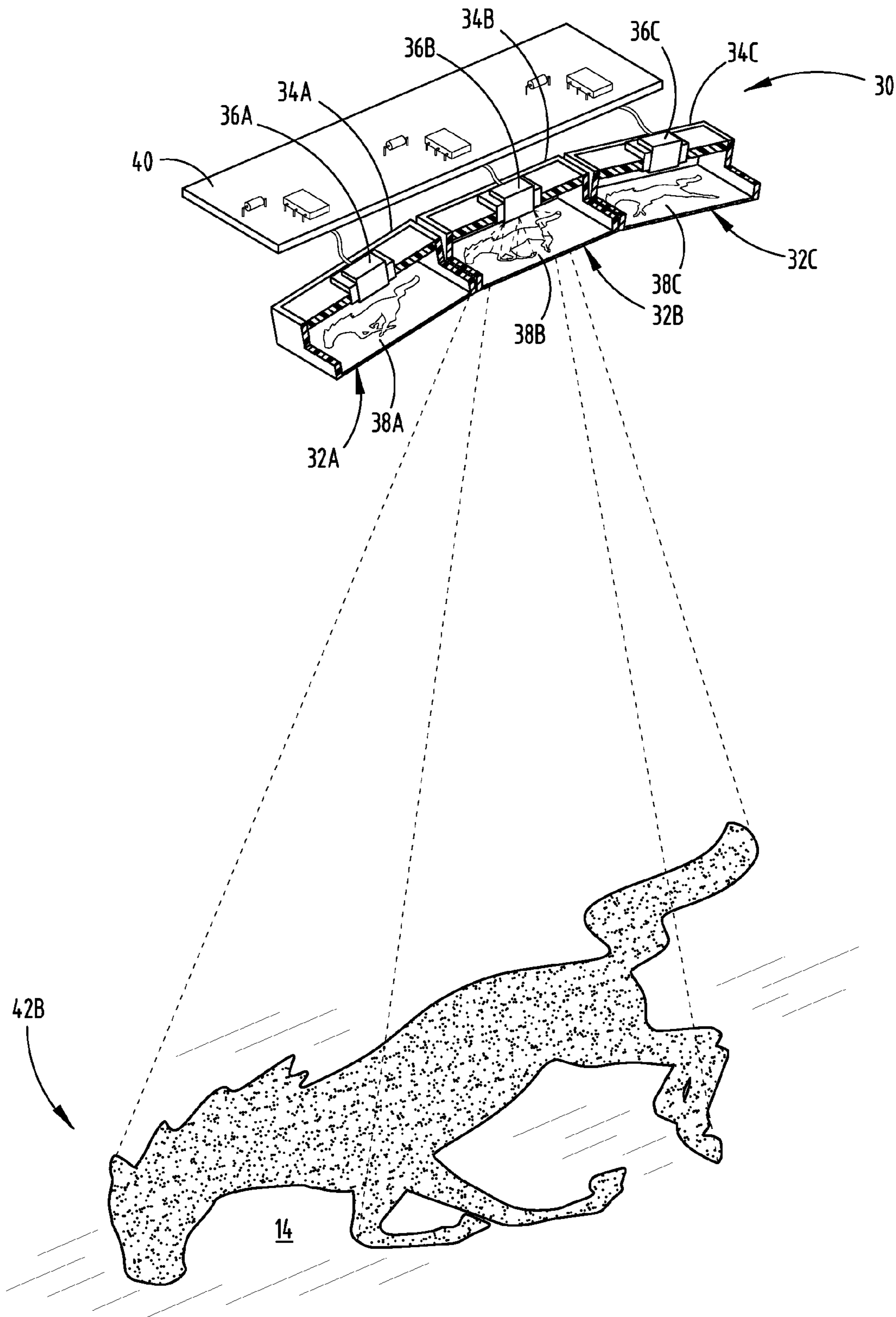


FIG. 2B

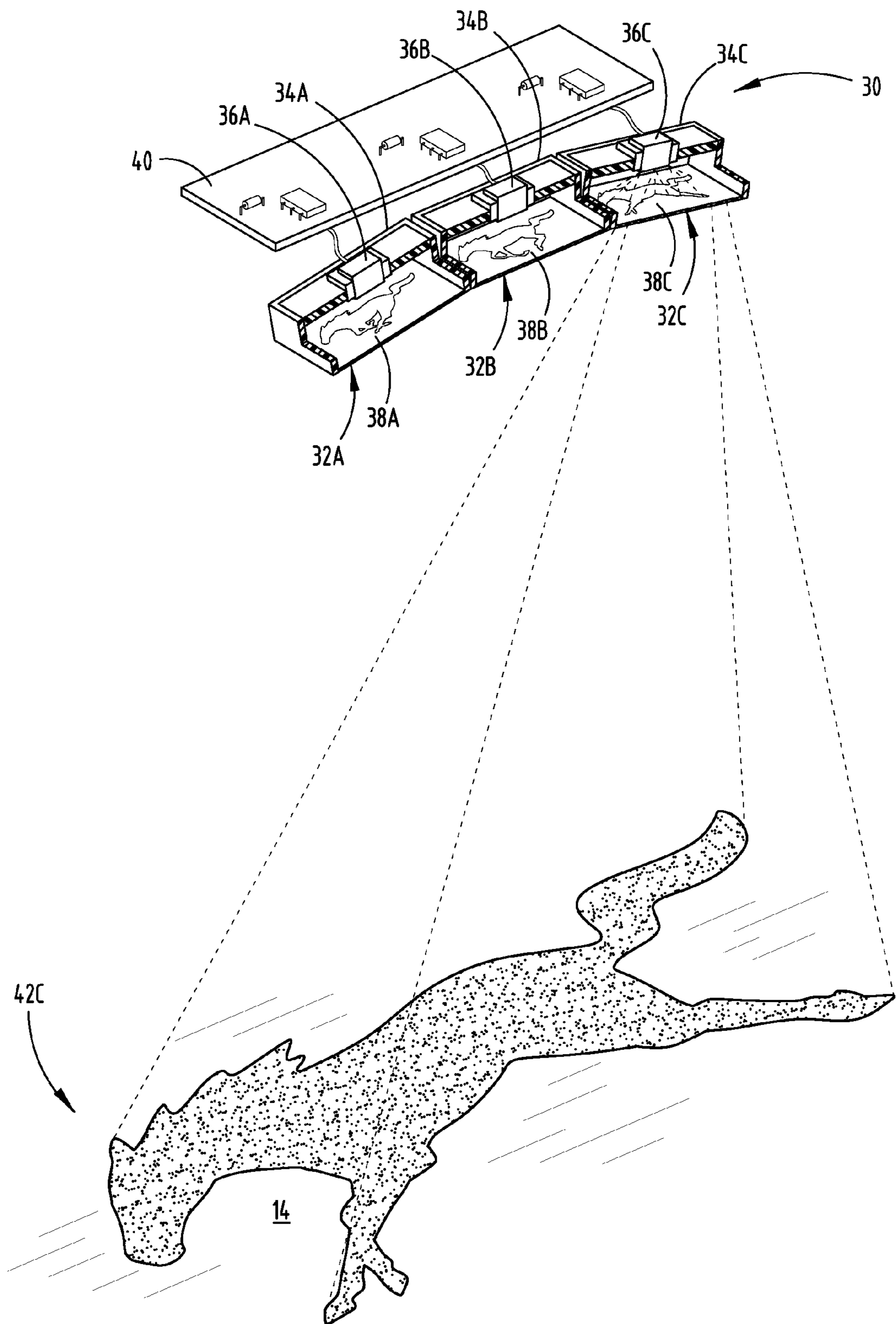


FIG. 2C

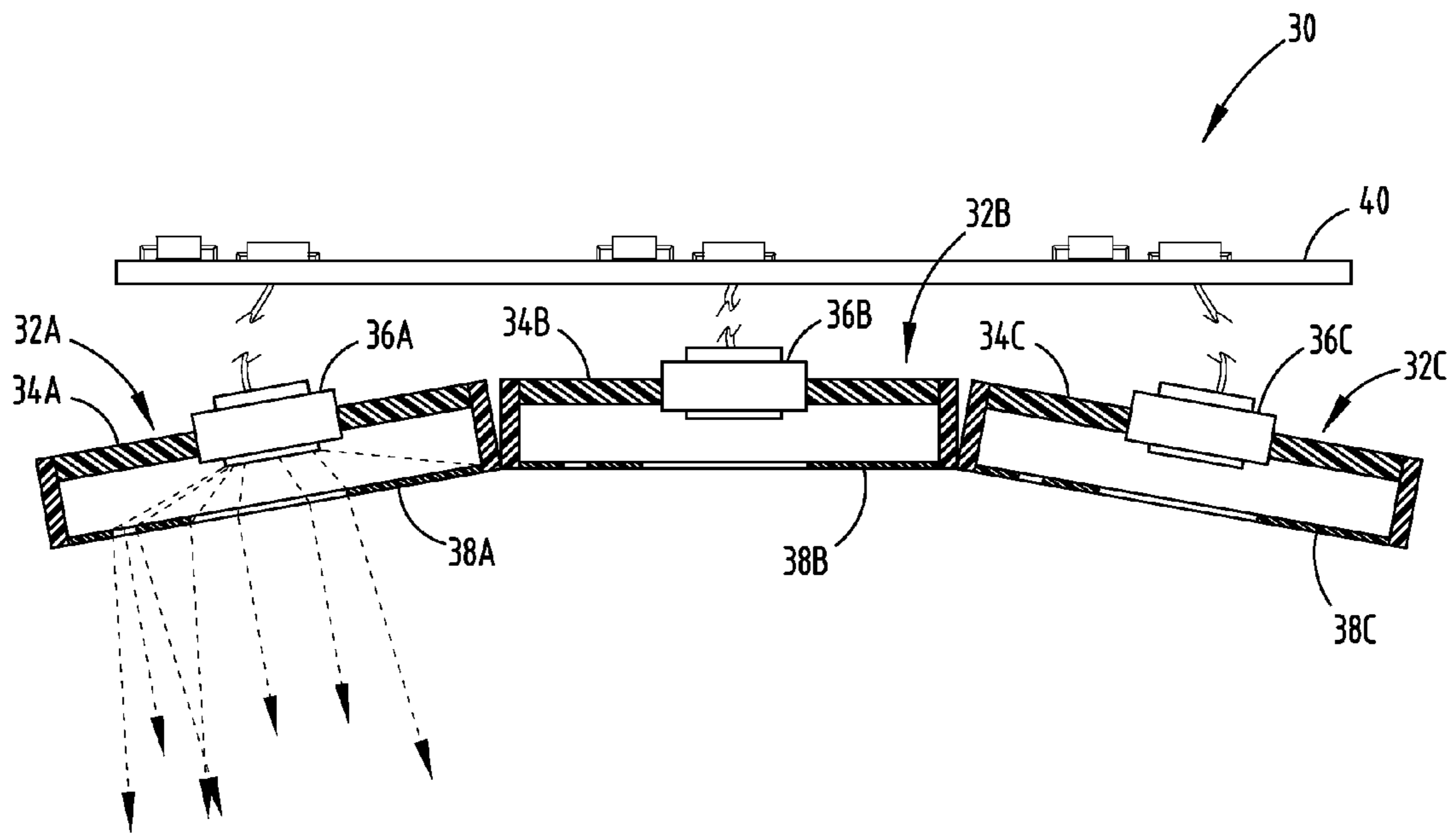


FIG. 3

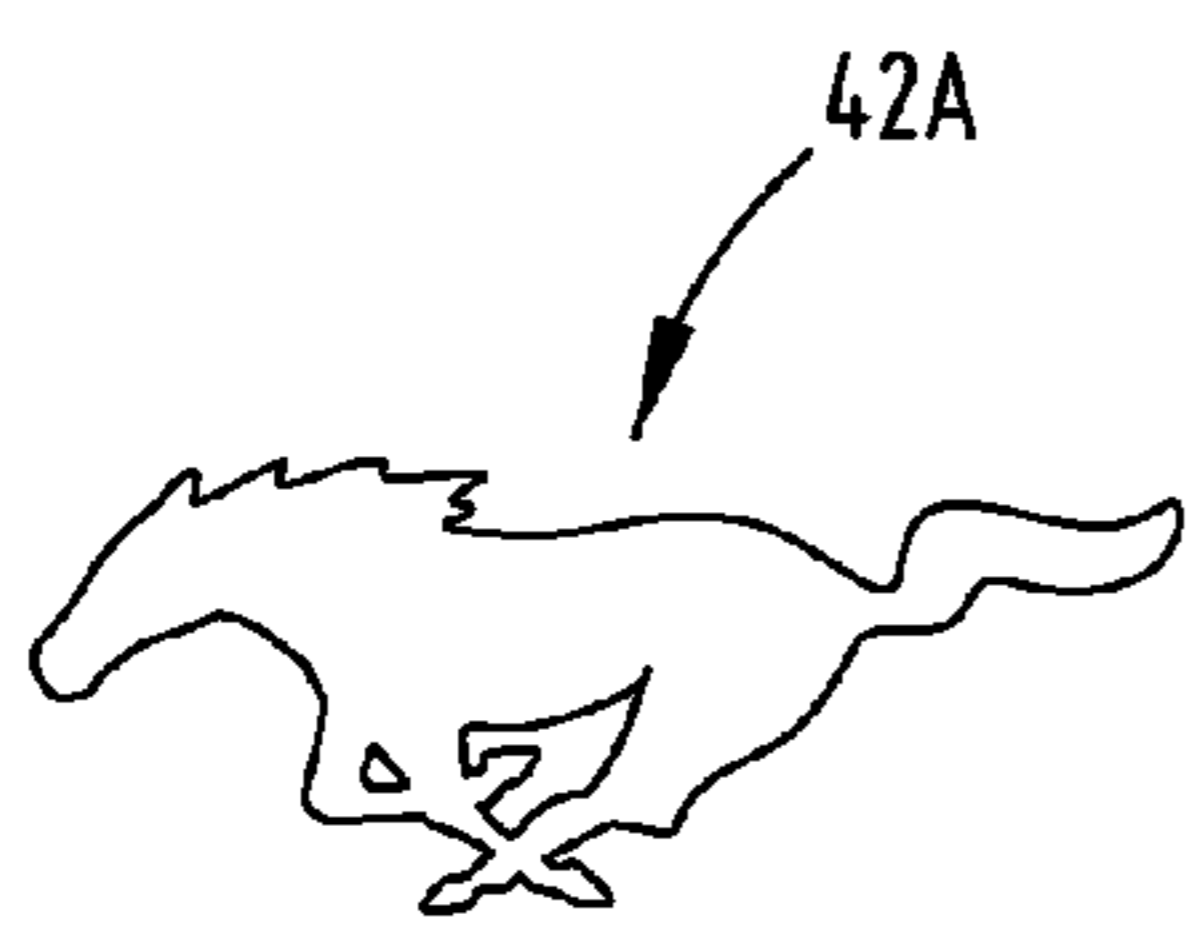


FIG. 4A

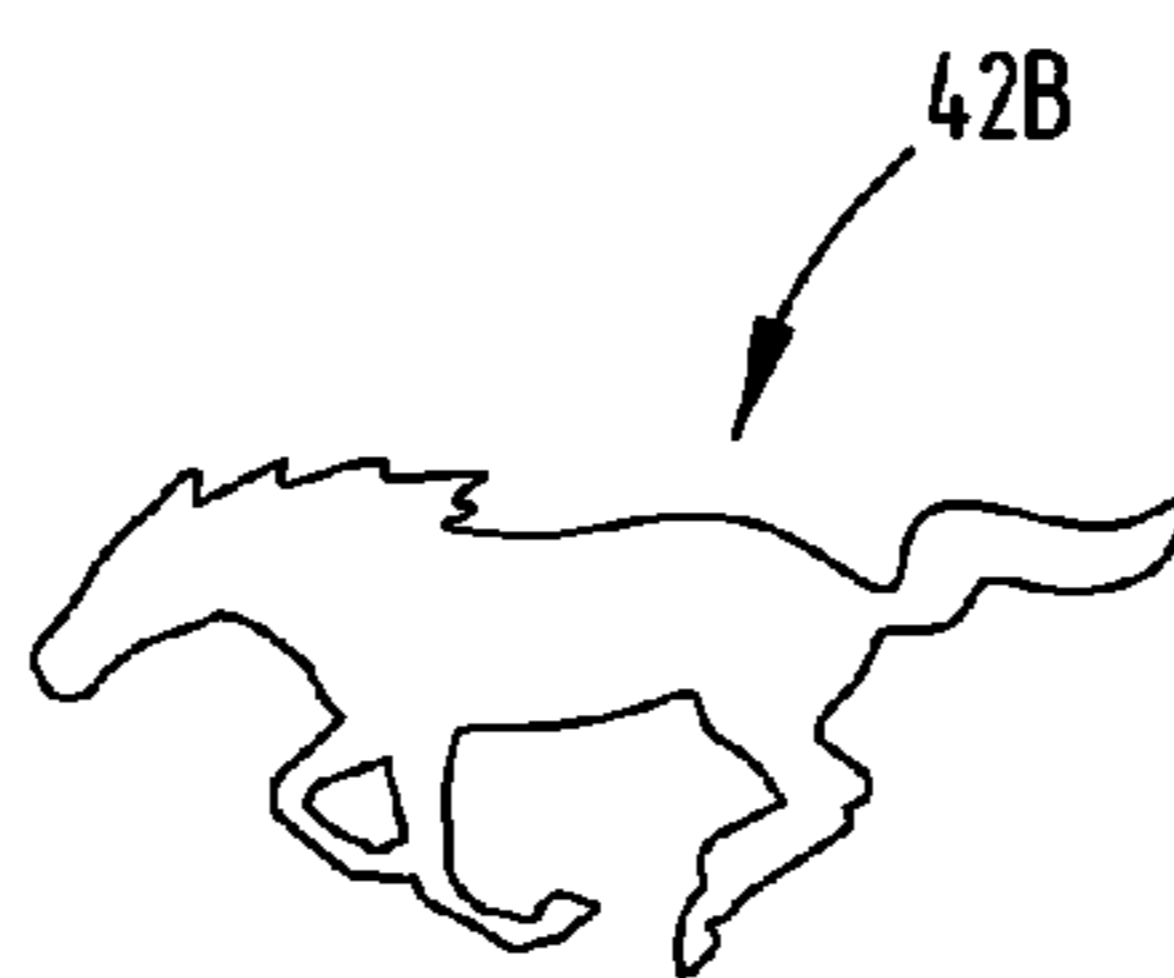


FIG. 4B

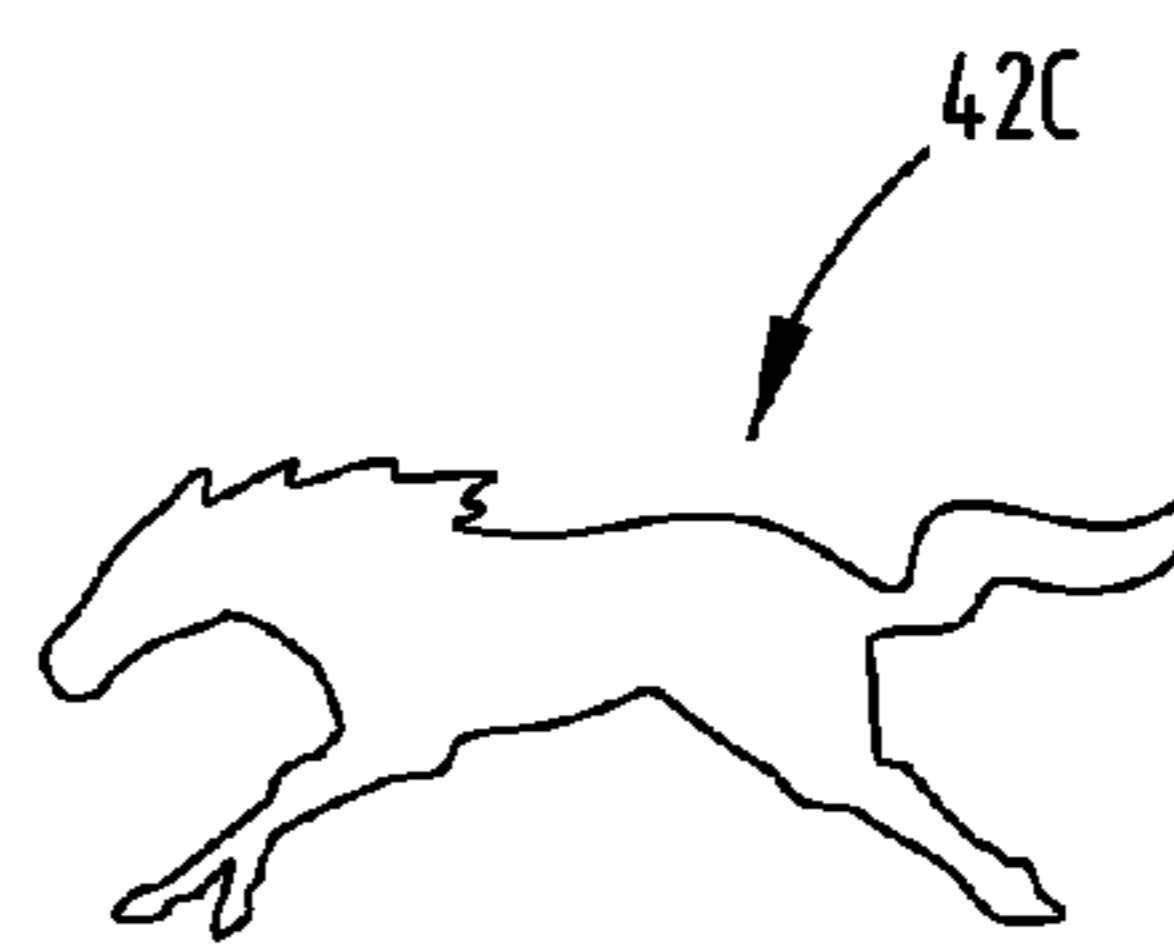


FIG. 4C

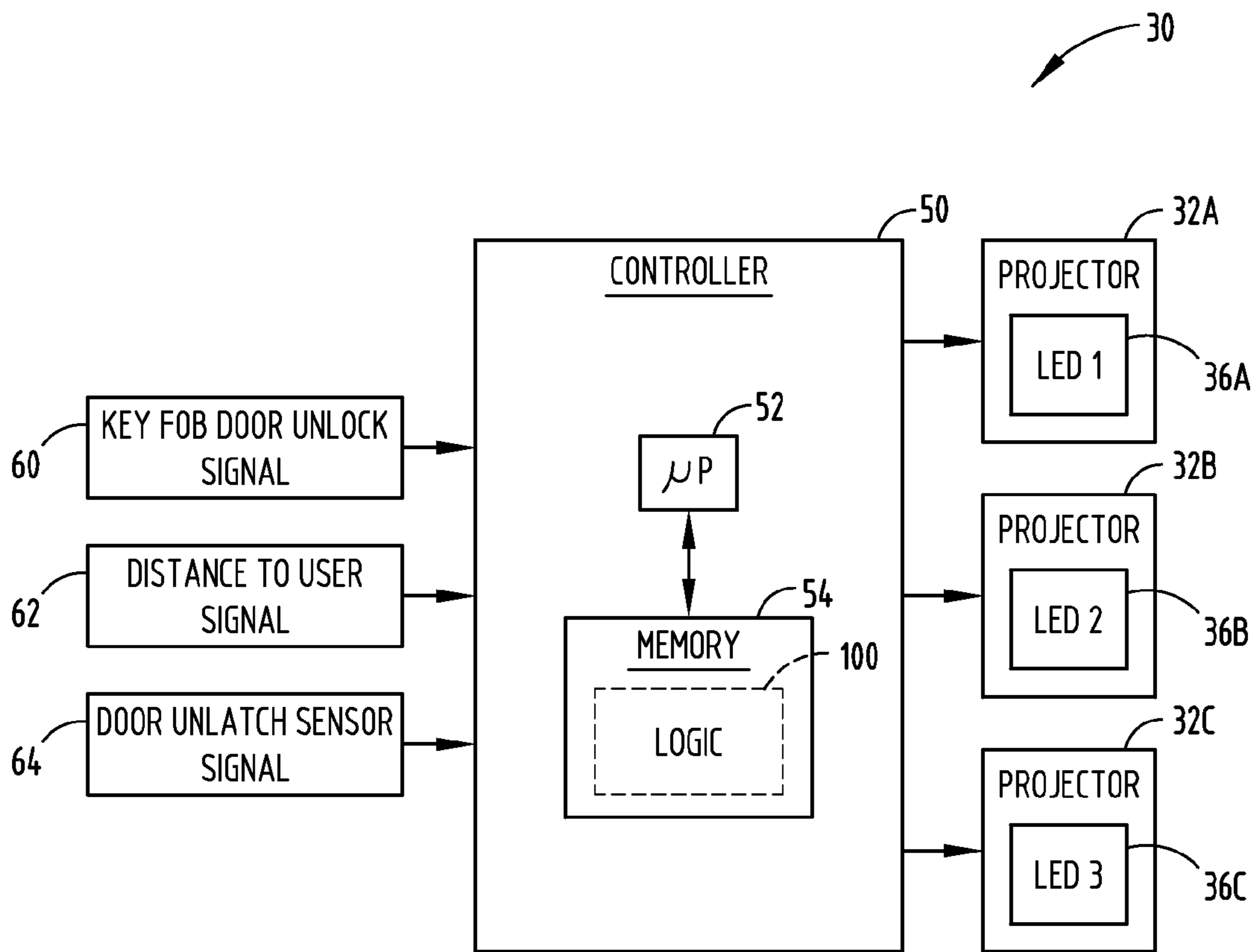


FIG. 5

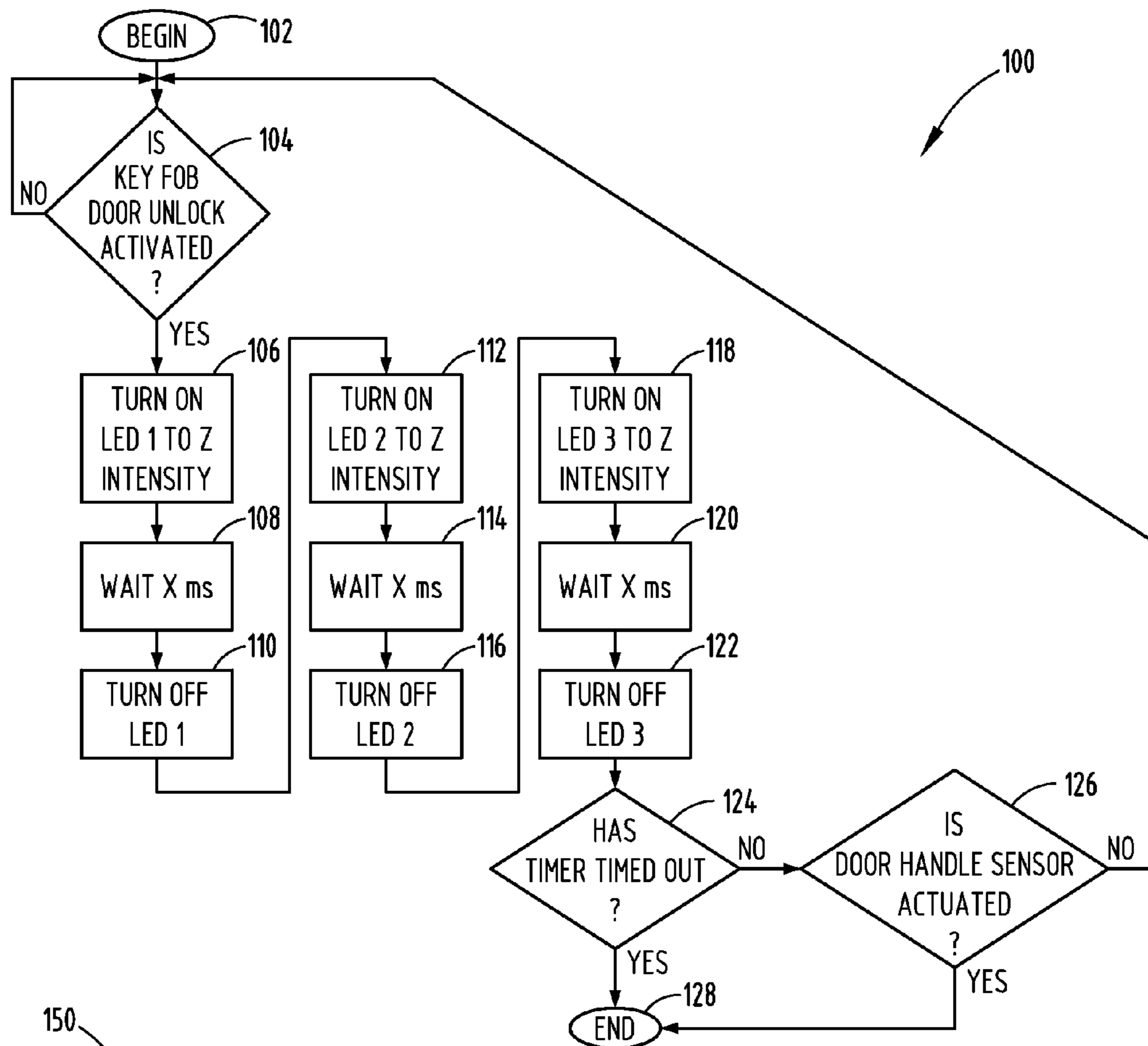


FIG. 6

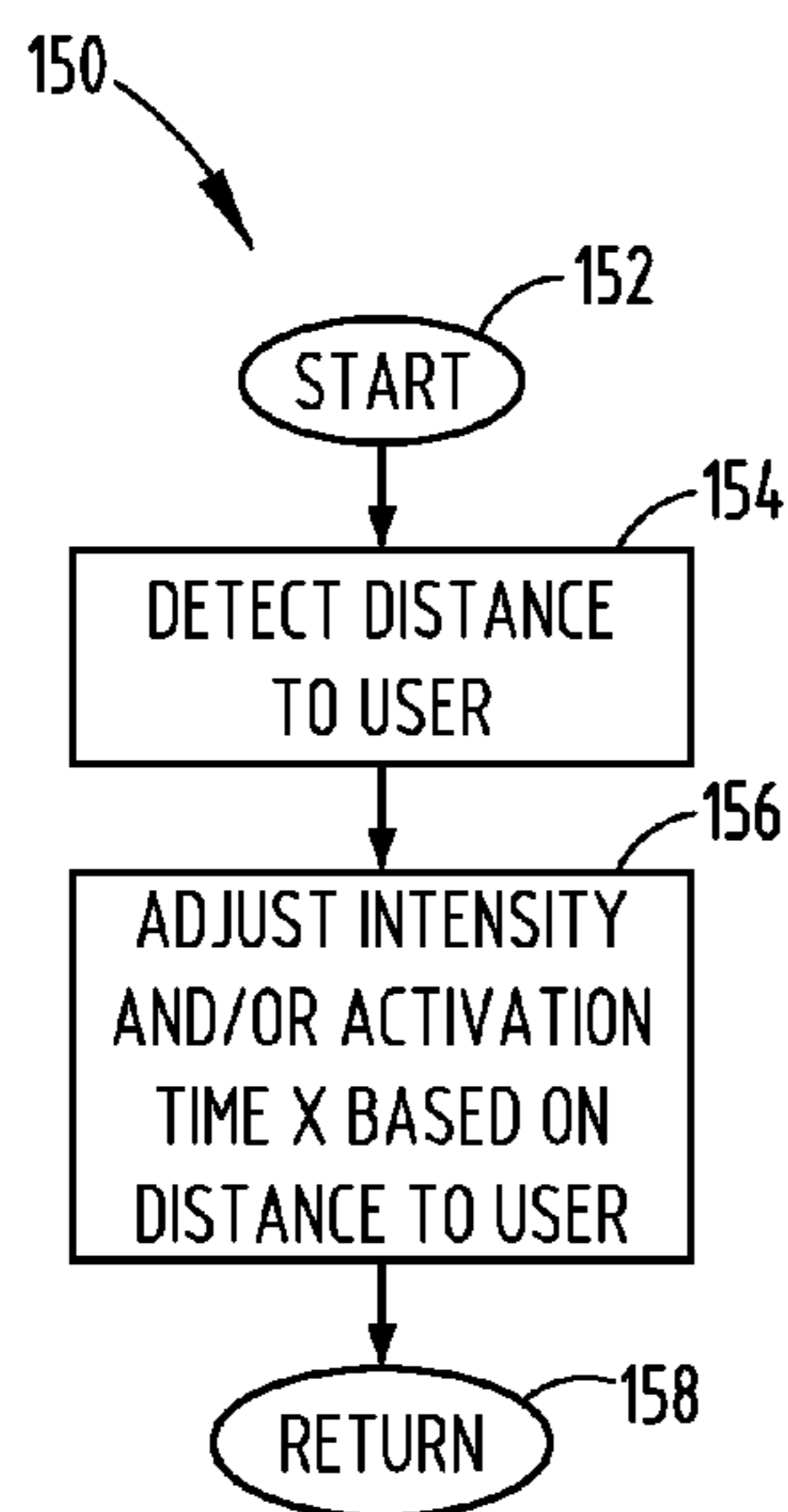


FIG. 7



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## VEHICLE PUDDLE LAMP ASSEMBLY GENERATING ANIMATED IMAGE AND METHOD

### FIELD OF THE INVENTION

The present invention generally relates to vehicle lighting, and more particularly relates to a vehicle puddle lamp assembly for providing an illuminated image on the ground surface adjacent to the vehicle.

### BACKGROUND OF THE INVENTION

Automotive vehicles are increasingly employing lighting devices such as puddle lamps for enhanced lighting applications. Puddle lamps have been employed to illuminate a beam of light onto the ground surface in an area adjacent to the vehicle door when the door is to be opened. The puddle lamp thereby provides illumination to a driver or passenger of the vehicle to observe the area for approaching or stepping out of the vehicle, such as the existence of a puddle of water.

### SUMMARY OF THE INVENTION

According to one aspect of the present invention, a vehicle puddle lamp assembly is provided. The vehicle puddle lamp assembly includes a plurality of light projectors located on a vehicle and configured to illuminate different lighted image patterns on a surface adjacent to the vehicle. The vehicle puddle lamp assembly also includes a controller for sequentially activating the plurality of light projectors to generate an animated lighted image on the surface.

According to another aspect of the present invention, a method of generating an animated lighted image with a vehicle puddle lamp assembly is provided. The method includes the steps of receiving a signal to activate a vehicle puddle lamp and sequentially activating a plurality of light projectors configured to illuminate different light patterns on a surface adjacent to the vehicle to generate an animated lighted image.

These and other aspects, objects, and features of the present invention will be understood and appreciated by those skilled in the art upon studying the following specification, claims, and appended drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of an automotive vehicle employing a puddle lamp assembly in an exterior side view mirror of a vehicle, according to one embodiment;

FIG. 1A is an enlarged view of section IA illustrating the exterior side view mirror with a plurality of light projectors employed by the lamp assembly;

FIG. 2A is an enlarged view of the lamp assembly illustrating the projection of a first lighted image with the first projector;

FIG. 2B is an enlarged view of the lamp assembly illustrating the projection of a second lighted image with the second projector;

FIG. 2C is an enlarged view of the lamp assembly illustrating the projection of a third lighted image with the third projector;

FIG. 3 is a cross-sectional view taken through line III-III of FIG. 2 further illustrating the light projectors;

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FIGS. 4A-4C are images of three different lighted image patterns generated by the three light projectors, according to one embodiment;

FIG. 5 is a block diagram further illustrating the puddle lamp assembly;

FIG. 6 is a flow diagram illustrating a method of controlling activation of the light projectors of the assembly, according to one embodiment; and

FIG. 7 is a flow diagram illustrating a routine of adjusting intensity and/or activation time of the light projectors, according to another embodiment.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are not necessarily to a detailed design; some schematics may be exaggerated or minimized to show function overview. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

Referring to FIGS. 1 and 1A, an automotive vehicle 10 is generally illustrated employing a vehicle puddle lamp assembly 30, according to one embodiment. The vehicle 10 shown is one example of a passenger vehicle having a pair of exterior rearview mirrors 12 mounted on opposite lateral sides of the vehicle generally near the front side of the front passenger doors 16, as is generally known in the art. Passenger doors 16 each include a handle 18 with a latch mechanism to enable a user to engage and unlatch the latch mechanism to open the door for access to enter and exit the vehicle. A remote key fob 22 is shown which may be operated by a user to activate various features including door lock and unlock functions. The handle 18 is shown including a proximity sensor 20, such as a capacitive sensor, for sensing the hand of the user in close proximity to the handle 18.

The vehicle puddle lamp assembly 30 is shown installed on an exterior rearward facing side view mirror 12, generally in a position configured to project an animated lighted image onto the ground surface 14 adjacent to a passenger side door of the vehicle 10. The lamp assembly 30 includes a plurality of light projectors located on the vehicle shown in one embodiment installed in the lower housing of the mirror 12. In the embodiment shown, three light projectors are configured in a linear array, each oriented to illuminate a different lighted image on the same general area of the ground surface 14. While three light projectors are shown and described herein as part of the puddle lamp assembly, it should be appreciated that two or more light projectors may be employed in various configurations and orientations. It should further be appreciated that the light projectors may be located at different locations on the vehicle such as in the vehicle door handle, the door itself, a side fender, a bumper, a roof rail or other locations sufficient to project a lighted image onto the ground surface 14.

The vehicle puddle lamp assembly 30 is controlled by a controller to sequentially activate the plurality of light projectors consecutively one at a time such that a corresponding lighted image pattern is output from each projector and projected onto the ground surface 14 one at a time at a sufficiently rapid rate to generate an animated lighted image which has the appearance of a moving image. In the specific example shown and described herein, an image of a mustang 42A

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which may be a logo and may serve as a trademark is shown in three different lighted image patterns in which the legs of the mustang appear to move due to the sequential and rapid consecutive activations of the three light projectors. It should be appreciated that other images having different patterns, sizes, and light colors may be generated.

The puddle lamp assembly **30** may be activated in response to a user activating the door unlock switch on the key fob **22** when the user is within signal communication range of the vehicle **10**. Upon activation of the door unlock switch or button, the vehicle puddle lamp assembly **30** is turned on to generate the animated lighted image, such as the running mustang. The lamp assembly **30** may remain on for a predetermined time period, such as two minutes, and may be turned off prior to the predetermined time period when a user's hand is detected by the proximity sensor **20** in close proximity to or actuating the door handle **18**. Accordingly, the appearance of the moving lighted image provides an animated lighted image and serves as a puddle lamp to illuminate the ground surface **14** adjacent to the vehicle door to enable the user to approach and access the vehicle **10** and view the ground surface **14** proximate thereto.

Referring to FIGS. **2A-4C**, the lamp assembly **30** is further illustrated having three light projectors **32A-32C** for generating three different lighted image patterns **42A-42C**. The lamp assembly **30** includes first light projector **32A**, second light projector **32B** and third light projector **32C**, all shown arranged in a linear array and slightly angled relative to one another so as to provide light illumination onto the same general area on the ground surface **14**. Each of the light projectors includes a housing **34A-34C**, a light source **36A-36C**, such as a light emitting diodes (LEDs), and an image filter **38A-38C**. The image filters **38A-38C** are arranged within the light output windows of the corresponding light sources **36A-36C**, respectively, such that light output by the light sources **36A-36C** is illuminated onto and passes through the image filters **38A-38C** one at a time to provide the lighted image patterns **42A-42C** projecting onto the ground surface **14**. The image filters **38A-38C** may include a light transparent film having either a positive or negative light transparent image. Additionally, the lamp assembly **30** is shown having a printed circuit board containing a controller having control circuitry including LED drive circuitry for controlling activation and deactivation of the light sources and hence the light projectors **32A-32C**. The LEDs and filters generate a visible light such as white light or other color(s).

In FIG. **2A**, the first light projector **32A** is shown activated such that the first light source **36A** illuminates light onto first image filter **32A** to generate a first lighted image pattern **42A** on ground surface **14**. In FIG. **2B**, the second light projector **32B** is shown activated such that the second light source **36B** illuminates light onto the second image filter **38B** to generate a second lighted image pattern **42B** on ground surface **14**. In FIG. **2C**, the third light projector **32C** is shown activated such that third light source **36C** generates a beam of light onto the third image filter **38C** to generate a third lighted image pattern **42C** onto the ground surface **14**. It should be appreciated that the light projectors **32A-32C** are activated and deactivated one at a time in a successive sequence at a rapid rate to generate animated imaging. In doing so, each light projector may be turned on for an activation time period in the range of about 50 to 500 milliseconds, and more preferably 50 to 250 milliseconds, and then turned off and the next light projector turned on immediately so as to generate the appearance of a moving lighted image, such as an animated running mustang. The activation time period could be extended up to 1.5 seconds, according to embodiments that generate a slower mov-

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ing image. The first, second and third lighted image patterns **42A-42C** are further shown in FIGS. **4A-4C**, respectively. With a sufficiently fast successive activation and deactivation of the light projectors, the mustang appears to be running as the legs as viewed by a user appear to move.

Referring to FIG. **5**, the vehicle puddle lamp assembly **30** is further illustrated having a controller **50** receiving various inputs and controlling each of the first, second and third projectors **32A-32C**, by applying signals to the light sources **36A-36C**. The controller **50** may include a microprocessor **52** and memory **54** as illustrated, according to one embodiment. It should be appreciated that the controller **50** may include control circuitry such as analog and/or digital control circuitry. Stored within memory **54** and executed by a microprocessor **52** is logic **100** for processing the various inputs and controlling each of the plurality of light projectors as described herein. The inputs to the controller **50** may include a key fob door unlock signal **60** which may be made available from another controller, e.g., body control module, within the vehicle in communication with the key fob via wireless communication. Additionally, the controller **50** receives a distance to user signal **62** which is a distance that the user is detected from the vehicle. The distance to the user signal may be generated by computing distance between the vehicle and the key fob, according to one embodiment. Another controller such as a vehicle body control module may supply the distance to user signal. According to other embodiments, the distance to the user signal could be generated using other sensors, such as an ultrasonic proximity sensor. The controller **50** further receives a door unlatch sensor signal **64**. The door unlatch sensor signal may be a signal sensed by the proximity sensor in the door handle, or may be a signal detected by activation of a sensor on the key fob.

The controller **50** processes the inputs and activates the lamp assembly **30** when the key fob door unlock signal **60** is received by turning the plurality of light projectors sequentially on and off one at a time. The controller **50** may activate the lamp assembly **30** in response to other signals such as a door unlock signal generated by a door mounted switch or a door open signal, according to other embodiments. The lamp assembly **30** may be turned off when a predetermined time period expires or when a user is detected opening a vehicle door via the door unlatch sensor signal **64** according to one embodiment. The controller **30** may further determine a distance from the vehicle to a user and may control intensity and/or time of activation for each of the light projectors, according to other embodiments.

Referring to FIG. **6**, the logic or method **100** of activating the vehicle puddle lamp assembly **30** is illustrated, according to one embodiment. Method **100** begins at step **102** and proceeds to decision step **104** to determine if the key fob door unlock button has been activated and, if not, returns. If the key fob door unlock button has been activated, method **100** proceeds to step **106** to turn on the first LED **1** to intensity **Z**, then proceeds to step **108** to wait for an activation time period of **X** milliseconds, before proceeding to step **110** to turn off the first LED **1**. Accordingly, a first cycle of the first projector turning on and off is complete. Next, method **100** proceeds to step **112** to turn on the second LED **2** to an intensity **Z**, and then proceeds to step **114** to wait for an activation time period of **X** milliseconds, before turning off the second LED **2** at step **116**. Thus, the second light projector has been turned on and off for a complete cycle. Next, method **100** proceeds to step **118** to turn on the third LED **3** to an intensity **Z**, and then proceeds to step **120** to wait for an activation time period of **X** milliseconds before turning off the third LED **3** at step **122**. At this point, a cycle of the third projector turning on and off is

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complete. Following successive sequential activations and deactivations of each of the first and second and third light projectors, method **100** proceeds to decision step **124** to determine if a timer has timed out since the key fob unlock was activated and, if so, ends at step **128**. If the timer has not timed out, method **100** proceeds to decision step **126** to determine if the door handle sensor has been actuated and, if so, ends at step **128**. If the door handle sensor has not been actuated, method **100** returns to step **104** to repeat the successive activations and deactivations of the plurality of light projectors.

Referring to FIG. 7, a method **150** for adjusting the intensity *Z* and/or activation time *X* of the light projectors of method **100** is provided, according to another embodiment. In this embodiment, method **150** begins at step **152** and proceeds to step **154** to detect a distance to the user. The distance may be detected by computing the distance between the vehicle and the key fob, according to one embodiment. According to other embodiments, proximity sensors, such as an ultrasonic sensor may be employed to detect a distance to a user. Based on the detected distance, method **150** proceeds to step **156** to adjust intensity *Z* and/or activation time *X* of the light projectors based on the distance to the user, before returning at step **158**. Accordingly, as the user approaches the vehicle, the intensity of the lighted image pattern generated by each light projector may be increased and/or the speed at which the projector images are changed and the image appears to be moving may be increased. The intensity can thereby increase or decrease as the customer approaches or moves away from the vehicle. For example, if the customer is within fifty (50) feet of the vehicle, the image projectors may be turned on and activated at ten percent (10%) intensity and may ramp up to fifty percent (50%) intensity as the user moves to within a distance of twelve (12) feet of the vehicle, and then ramp to one hundred percent (100%) of the intensity as the user reaches a distance of five (5) feet from the vehicle. The *X* activation time may be changed to make the image appear to move at a faster or slower rate. The *X* activation time period may be shortened (decreased) to make the image to appear to move faster as the user approaches the vehicle and may be extended (increased) as the user moves further away from the vehicle, according to one example.

Accordingly, the vehicle puddle lamp assembly **30** advantageously provides light illumination in a region to the side of the vehicle door to allow enhanced access lighting. The lamp assembly **30** generates an animated image which gives the appearance of a moving lighted image on the ground surface adjacent to the vehicle to provide an aesthetically pleasing light illumination. It should be appreciated that the puddle lamp assembly **30** may be employed on opposite lateral sides of the vehicle as well as other locations on the vehicle to provide light illumination and a lighted animated image.

It is to be understood that variations and modifications can be made on the aforementioned structure without departing from the concepts of the present invention, and further it is to be understood that such concepts are intended to be covered by the following claims unless these claims by their language expressly state otherwise.

What is claimed is:

**1.** A vehicle puddle lamp assembly comprising:

a plurality of light projectors located on a vehicle and configured to illuminate different lighted image patterns on a surface adjacent to the vehicle;

a sensor sensing a distance between the vehicle and a user; and

a controller sequentially activating the plurality of light projectors to generate an animated lighted image on the surface and adjusting intensity of the plurality of light

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projectors and speed at which the animated image changes based on the sensed distance.

**2.** The lamp assembly of claim **1**, wherein the controller turns the plurality of light projectors on and off one projector at a time.

**3.** The lamp assembly of claim **2**, wherein the controller turns one of the light projectors on for a time period in the range of 50 to 500 milliseconds.

**4.** The lamp assembly of claim **1**, wherein the plurality of light projectors comprises first, second and third projectors, each comprising a light source and a filter operatively coupled to the light source for generating the image pattern.

**5.** The lamp assembly of claim **1**, wherein the plurality of light projectors are located in a vehicle exterior side view mirror for generating lighted image patterns on a ground surface adjacent to a vehicle door.

**6.** The lamp assembly of claim **1**, wherein each of the plurality of light projectors comprises a light source and a filter comprising an image pattern located in front of the light source.

**7.** The lamp assembly of claim **1**, wherein the controller activates the light projector in response to a control signal and further deactivates the light projectors when an occupant is sensed opening a door of the vehicle.

**8.** The lamp assembly of claim **7**, wherein the control signal is generated in response to a door open signal.

**9.** The lamp assembly of claim **1**, wherein the controller controls the speed at which the animated lighted image changes by controlling a time of activation of each of the light projectors based on the sensed distance.

**10.** A method of generating an animated lighted image with a vehicle puddle lamp assembly, comprising:

receiving a signal to activate a vehicle puddle lamp;

determining distance between the vehicle and a user;

sequentially activating a plurality of light projectors configured to illuminate different light patterns on a surface adjacent to the vehicle to generate the animated lighted image; and

controlling speed at which the animated light image changes based on the sensed distance.

**11.** The method of claim **10** further comprising the step of sensing an occupant in contact with the vehicle and deactivating the plurality of light sources when the occupant is sensed.

**12.** The method of claim **10**, wherein the step of sequentially activating the plurality of light projectors comprises turning the plurality of light projectors on and off one projector at a time.

**13.** The method of claim **12**, wherein the step of sequentially activating the plurality of light projectors comprises turning one of the light projectors on for a time period in the range of 50 to 500 milliseconds.

**14.** The method of claim **10**, wherein the plurality of light projectors comprises first, second, and third light projectors, each comprising a light source and a filter operatively coupled to the light source for generating the image pattern.

**15.** The method of claim **10**, wherein the plurality of light projectors are located on a vehicle exterior side view mirror for generating lighted image patterns on a ground surface adjacent to a vehicle door.

**16.** The method of claim **10**, wherein the step of receiving a signal comprises receiving a vehicle door open signal generated by a key fob.

**17.** The method of claim **10** further comprising the step of controlling intensity of light illuminated by each of the plurality of light projectors based on the sensed distance.

**18.** A vehicle puddle lamp assembly comprising:  
a plurality of light projectors located on a vehicle and  
configured to illuminate different lighted image patterns  
on a surface adjacent to the vehicle;  
a sensor sensing distance between the vehicle and a user; 5  
and  
a controller sequentially activating the plurality of light  
projectors to generate an animated lighted image on the  
surface and adjusting speed at which the animated  
lighted image changes based on the sensed distance. 10

**19.** A method of generating an animated lighted image with  
a vehicle puddle lamp assembly, comprising:  
receiving a signal to activate a vehicle puddle lamp;  
determining distance between the vehicle and a user;  
sequentially activating a plurality of light projectors con- 15  
figured to illuminate different light patterns on a surface  
adjacent to the vehicle to generate the animated lighted  
image; and  
controlling intensity of light illuminated by each of the  
plurality of light projectors and speed at which the ani- 20  
mated image changes based on the sensed distance.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 9,321,395 B2  
APPLICATION NO. : 13/871065  
DATED : April 26, 2016  
INVENTOR(S) : Ali Ammar et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Column 6, claim 10, line 40;

“light” should be -- lighted --.

Signed and Sealed this  
Nineteenth Day of July, 2016



Michelle K. Lee  
*Director of the United States Patent and Trademark Office*